



SIDa Roadmap: Navigating Regional Innovation Governance Through the Dodeca-Helix Model for Sustainable Development

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Abstract

Strengthening the Regional Innovation System (SIDa) in Wajo Regency faces challenges such as policy fragmentation, lack of multi-stakeholder synergy, and misalignment between regulatory frameworks and local needs. This study aims to develop a SIDa Roadmap based on the Dodeca-Helix model, encompassing 12 stakeholders, to create an inclusive and sustainable innovation ecosystem. The research employs a well-being methodology, a mixed-method approach, and thematic analysis to explore community perceptions, participation, and acceptability regarding innovation needs. Primary data were collected through surveys involving 250 respondents, in-depth interviews, and focus group discussions, while secondary data were obtained from official government documents and academic literature. The findings reveal that the Dodeca-Helix model facilitates synergy among government, academia, society, industry, and other stakeholders through the Innovation Hub (I-Hub). Five key variables—innovative human resources, adaptive regulations, cross-actor partnerships, community participation, and environmental sustainability—serve as the main drivers of the innovation ecosystem. While challenges such as network complexity management and cross-institutional coordination are identified, solutions include developing digital collaboration platforms and incentive mechanisms. The study recommends institutionalizing the I-Hub, strengthening human resource capacity, formulating flexible regulations, and mainstreaming

sustainability as strategic measures. Theoretically, these findings contribute to regional innovation literature while practically providing a guide for policymakers in Wajo Regency to establish a responsive, inclusive, and sustainable innovation ecosystem.

Keywords: SIDA Roadmap, Regional Innovation Governance, Dodeca-Helix, Sustainable Development, and Wajo Regency

Introduction

Regional innovation is influential in creating sustainable development, especially for regions adapting to global and local challenges. In an era of increasingly complex disruption, regional innovation is the main factor for sustainable development, especially when facing global dynamics and local challenges. This situation is also experienced by Wajo Regency, which faces the problem of policy fragmentation, limited synergy and multi-party collaboration, minimal synergy between local resources and global needs, and the absence of a responsive innovation ecosystem (Etzkowitz, 2003a; Raworth, 2018b). In fact, in the context of sustainable development, strengthening the governance of the Regional Innovation System (SIDa) is a crucial strategic challenge, especially for Wajo Regency, which is in the transition stage towards a more inclusive and competitive innovation ecosystem (Leydesdorff, 2020; Shkarupeta & Babkin, 2024). The main problem is the lack of synergy between stakeholders and the mismatch between regulatory policies and local innovation needs. The Dodeca-Helix model as a multidimensional approach offers a solution to this problem by creating an innovation ecosystem based on cross-sector collaboration (Carayannis, 2020; Saksono, 2020b).

These challenges raise a critical question: How the Dodeca-Helix model be adapted to strengthen regional innovation governance through the SIDA Roadmap in Wajo Regency? Through this question, key variables that influence the successful implementation of the Dodeca-Helix model will be revealed, and the extent to which the resulting innovation ecosystem can create inclusive and sustainable development (Raworth, 2018)(Raworth, 2018; Rodriguez-Pose & Midelfart, 2021).

The main objective of this research is to develop a Roadmap for Strengthening SIDA based on the Dodeca-Helix model, emphasizing the integration of five key variables: innovative human resources, policies and regulations, multi-actor partnerships, community participation, and environmental and social sustainability (Rahmi et al., 2021; Yashiro, 2023). This approach is expected to be a practical guide for the Wajo Regency Government in creating an innovation ecosystem that is more responsive and adaptive to global change. Theoretically, this study refers to the dynamics of the innovation governance model as initiated by the "Triple Helix" model, which integrates the roles of universities, industry, and government in creating innovation (Etzkowitz, 2003b). However, the Triple Helix innovation governance model is no longer adequate to address multidimensional challenges and is even

inadequate to deal with the complexity of challenges and capture current innovation opportunities (Etzkowitz, 2003c; Leydesdorff, 2020)

The Quadruple-Helix model is a development of the Triple Helix, adding the dimension of “Media and Culture” as an important element in the innovation ecosystem. This dimension focuses on how information, public opinion, and communication influence innovation. (Carayannis, 2020b; Etzkowitz, 2003d). In the context of Wajo Regency, the media has a strategic role in spreading innovative ideas by strengthening the community acceptability of innovation programs. In addition, local culture can be a source of inspiration for innovation based on local wisdom, which supports the development of specific solutions based on regional contexts (Yin et al., 2022) (Cornwall & Coelho, 2021; Yin et al., 2022).

Quadruple-Helix enables active community involvement through media and culture to create a more democratic public dialogue space. The existence of this dimension helps bridge the gap between government, academics, and industry by involving the community as a strategic actor in innovation (Etzkowitz, 2003f)

In the Quintuple-Helix model, two important dimensions are added, namely, environmental sustainability (ecological sustainability) and society (society and culture). This addition makes the innovation ecosystem more relevant to the principle of sustainability while reflecting awareness of the importance of ecological sustainability in innovation, which is not only oriented towards the economy but also considers ecological balance as stated (Shkarupeta & Babkin, 2024a) and (Raworth, 2018) within the framework of Doughnut Economics which emphasizes the importance of balance between economic growth and ecological limits.

In the Quintuple-Helix, the environment is treated as an innovation actor on par with other entities, where economic development cannot be separated from ecological sustainability (Peñalosa & Kleine-Rueschkamp, 2024). Likewise, the community is a subject and an agent of change that can encourage innovation based on local wisdom (Yashiro, 2023)(Cornwall & Coelho, 2021; Yashiro, 2023). Implementing the Quintuple-Helix in Wajo Regency involves integrating local needs and global initiatives, such as strengthening human resources that are adaptive to ecological challenges through innovative education (Makmur et al., 2021). Thus, this model provides a framework for understanding innovation as a dynamic and inclusive process, balancing economic growth and environmental sustainability as its main priorities. In other words, the Quintuple-Helix is a framework that ensures that innovation is not only economically relevant, but also contributes to social and ecological sustainability.

This model is expanded with the "Quintuple Helix," which adds environmental and societal dimensions (Shkarupeta & Babkin, 2024b). and translated into the "Dodeca-Helix" which includes 12 stakeholders (Zhou & Etzkowitz, 2021a). The theoretical approach reflects the latest developments in innovation studies and offers an applicable framework. In Wajo

Regency, the integration of environmental aspects can be done through the development of environmentally friendly innovations, such as green infrastructure and clean technology, which support the sustainable development agenda (Peñalosa & Kleine-Rueschkamp, 2024).

The advancement of digital technology has triggered a transformation in the innovation ecosystem. Hexa-Helix adds the technological (digital) dimension as a key actor, providing new opportunities to create a more effective collaboration platform (Brunetti et al., 2020a). In the context of Wajo Regency, digital technology can be used to accelerate the innovation process, such as through smart governance, e-marketplace, and digital-based collaboration platforms that enable real-time involvement of various stakeholders (Saksono, 2023a).

Hexa-Helix plays a role in overcoming rigid and less flexible bureaucratic obstacles. According to (Brunetti et al., 2020b), digital technology can support regulatory flexibility through a "regulatory sandbox" that allows policy experimentation with controlled risks. This technology opens up space for local governments to create policies that are adaptive and responsive to the needs of the community, as emphasized (Yashiro, 2023) on the need for adaptive innovation governance that integrates technology as a key tool to improve policy efficiency and effectiveness.

The development of digital technology has created new opportunities to overcome innovation barriers. Hexa-Helix adds technology as an important dimension, enabling the creation of a digital-based collaboration ecosystem (Brunetti et al., 2020c; Saksono, 2023b). In Wajo Regency, digital technology can be utilized to accelerate the decision-making process, such as through e-governance, smart city platforms, and community-based digital innovation.

The complexity of multidimensional innovation becomes strategic when adopting the Dodeca-Helix model, which includes 12 stakeholders, including central and regional governments, academics, industry, civil society, media, grassroots communities, and other relevant actors in the innovation ecosystem (Zhou & Etzkowitz, 2021b). Dodeca-Helix is the most relevant approach for Wajo Regency, which has social, economic, and political complexity, considering the complexity of the actors involved in the SIDa Strengthening Roadmap document. Dodeca-Helix offers an approach that is not only democratic and inclusive but also responsive to global and local dynamics. Because the Dodeca-Helix model allows for more dynamic synergy between stakeholders through the "Innovation Hub" (Saksono, 2020a). I-Hub becomes a collaborative space where knowledge, resources, and innovations can be exchanged productively. In the study Rodriguez-Pose & Midelfart (2021), argues that this approach creates an innovation ecosystem that is capable of facing multidimensional challenges, such as climate change, technological disruption, and social dynamics.

Observing the differences and uniqueness of several previous studies (State-of-the-Art), this study integrates the Doughnut Economics framework (Raworth, 2018) and cross-

actor innovation approaches (Cornwall & Coelho, 2021). Integrating different helix theories into a single framework that offers a new way to understand SIDA through ecological sustainability, digital technology, and cross-actor collaboration is a transitional stage towards the Dodeca-Helix. Furthermore, the enrichment process is carried out by adopting a welfare/benefit methodology that emphasizes the importance of public perception, participation, and acceptability (PPA) in the formulation of the SIDA Strengthening Roadmap, making it more comprehensive (Cornwall & Coelho, 2021; Rodriguez-Pose & Midelfart, 2021). This enrichment provides theoretical contributions by developing the Dodeca-Helix model, including practical implications for policymakers in Wajo Regency to design and implement more adaptive and inclusive regional innovations.

The novelty being offered is the adoption of the doughnut economics methodology.. (Raworth, 2018) in the design of regional innovation ecosystems. This paradigm emphasizes the balance between economic and ecological sustainability and creates space for the democratization of innovation through transformative participation mechanisms (Cornwall & Coelho, 2021). It is hoped that through this study, the literature related to regional innovation will be further enriched and real contributions to developing evidence-based policies in Wajo Regency will be made. Therefore, a more comprehensive approach through Quadruple-Helix, Quintuple-Helix, Hexa-Helix, and Dodeca-Helix, becomes relevant to strengthen SIDA governance while creating a more adaptive, inclusive, and sustainable innovation ecosystem (Carayannis, 2020; Saksono, 2020b; Shkarupeta & Babkin, 2024).

Methods

This study used the wellbeing methodology (WM) framework as developed (Raworth, 2018) focusing on multidimensional welfare, community empowerment, social transformation, and regional innovation-based development progress. A mixed-method approach with the WM paradigm explores the locality and dynamics of complex social change in SIDA Governance in Wajo Regency through the lens of Perception, Participation, and Acceptability (PPA). This means this study presents an innovative approach to exploring SIDA, focusing on subjective experiences and structural dynamics through a comprehensive WM framework. Referring to Cornwall & Coelho (2021), This approach allows for a holistic understanding that goes beyond traditional research paradigms, focusing on subjective experiences and structural dynamics in the context of regional innovation.

Primary data needs were obtained from a survey of 250 respondents using the Google Form (GF) instrument. In addition, in-depth interviews and focus group discussions (FGD) were also conducted along with participatory observations of several selectively selected loci. Secondary data were obtained from several official documents of the Wajo Regency Government, the Regional Innovation Report from the Ministry of Home Affairs, and several academic literature that reviews regional innovation. The process of obtaining secondary data is a crucial stage in this research to ensure the validity and legitimacy of the data used. This process begins with the preparation of an official application letter from the research

institution addressed to the relevant government agency, then the letter is accompanied by a research proposal, cover letter, and the identity of the researcher and clear research objectives to show the urgency and relevance of data collection. After the application is submitted, the administrative verification process is carried out by the government agency, which includes clarification of the research objectives, a short interview, or a request for additional supporting documents. Once approved, the documents are submitted in printed or digital form, accompanied by a data collection permit or official memo. It is important for researchers to maintain good communication and bureaucratic ethics during this process, as well as comply with the government's privacy policies and data usage restrictions, so that the research runs smoothly and the results can be accounted for scientifically and administratively.

According to Rodriguez-Pose & Midelfart (2021), the diversity of data sources allows triangulation of information to produce comprehensive and credible findings. The data analysis techniques used are thematic analysis and descriptive statistics to describe the perception, participation, and acceptability of respondents regarding the need for innovation that should be included in the Wajo Regency SIDa Strengthening Roadmap 2025-2026.

Results

Realistically, the transformation of the regional innovation paradigm can be done in two (2) ways, namely: 1) a top-down approach and 2) a bottom-up approach. Both approaches lead to the growth of a more dynamic, participatory, and sustainable regional innovation ecosystem. Uniquely, the synergy, collaboration, and interaction between the twelve (12) Stakeholders in the growth of the regional innovation ecosystem through the Innovation Hub (I-Hub) is illustrated in Figure 1.

Figure 1 presents a complex and multidimensional innovation ecosystem model, representing the current regional innovation collaboration conception. Referring to the study (Leydesdorff & Smith, 2022) about the evolution of innovation models, this "Dodeca-Helix" construction goes beyond the traditional triple-helix, quadruple-helix, quintuple-helix, and hexa-helix paradigms to a much more complex, sophisticated, accommodating, and productive system of stakeholder interaction in innovation. According to Rodriguez-Pose & Midelfart (2021), the complexity of this network creates an "innovation ecosystem" that allows for the exchange of knowledge, resources, and innovation dynamically and non-linearly. Each entity no longer operates independently but forms an interdependent network that needs each other, supports, complements, motivates, and strengthens the quality of regional innovation.

Habermas's perspective on public space, developed by (Cooke et al., 2024) is reflected in this model. Every stakeholder has the potential to be a "transformation agent" capable of disrupting conventional structures through dialogue, collaboration, and the exchange of innovative ideas.

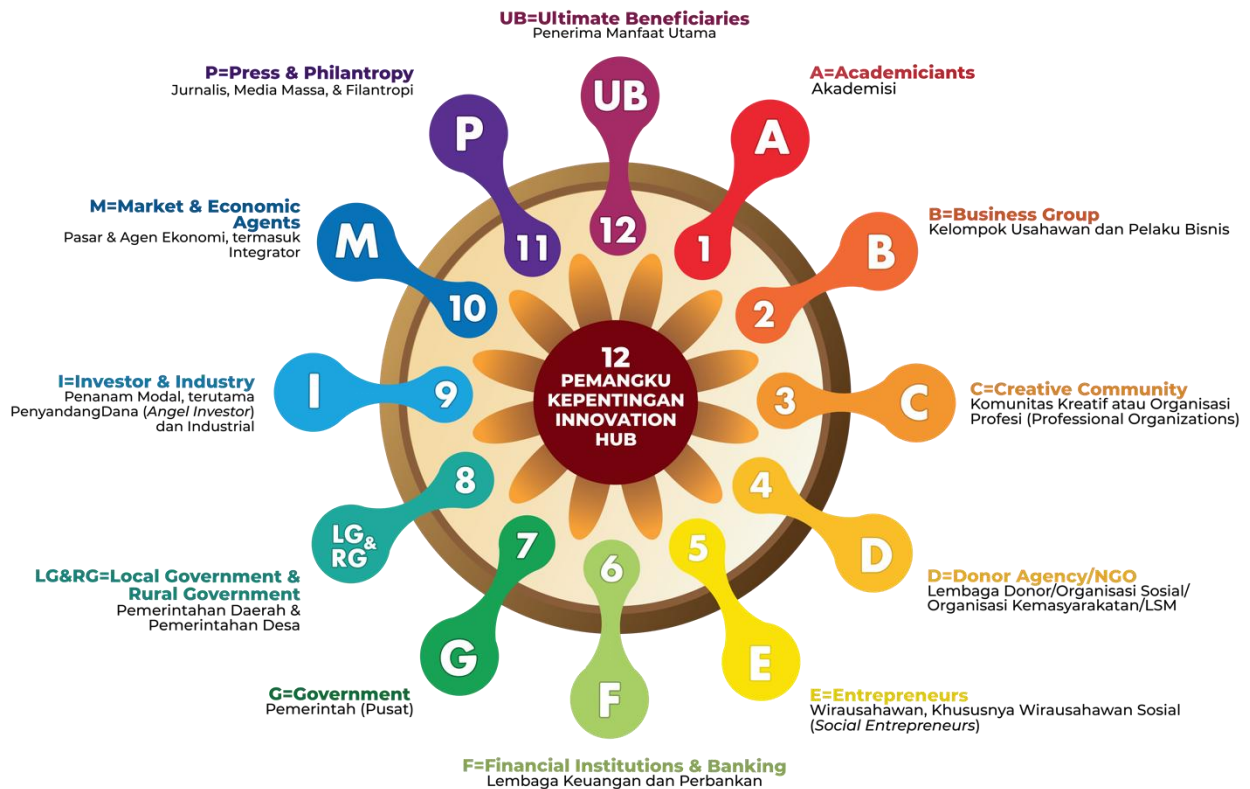


Figure 1. Synergy and Interaction of 12 Innovation Hub (I-Hub) Stakeholders

Epistemologically, the Dodeca-Helix model deconstructs the traditional hierarchy in knowledge production. There is no single source of truth but multiple knowledge production centers that synergize, interact, and interconnect. This is in line with the postmodern paradigm in innovation studies developed by Gibbons et al. (2020) about mode-2 knowledge production.

Administratively, technically-operationally, and managerially, the Dodeca-Helix model has unique features, namely: 1) structural flexibility; 2) high adaptability; 3) cross-border potential in innovation; 4) democratization of the innovation process; and 5) guaranteed quality in the innovation process and products. However, it is also predicted that there will be major challenges in the implementation of the Dodeca-Helix model, including 1) network complexity management, 2) differences in interests between actors, 3) balance of power relations, 4) cross-institutional coordination, and 5) risk calculation and management of its handling.

According to (Yashiro, 2023), regarding innovation governance, the success of the Dodeca-Helix model depends heavily on transformative leadership, strong communication infrastructure, collaborative incentive mechanisms, and a culture of openness and trust among stakeholders in the I-Hub.

The Dodeca-Helix model, as illustrated by Figure 1, is a structural representation and a new epistemological manifesto for understanding regional innovation. This Dodeca-Helix model presents a regional innovation ecosystem that is more realistic, democratic, inclusive, and responsive to the complexity of contemporary social change in the digital era. For the smooth operation of the regional innovation ecosystem through I-Hub, the development of cross-actor collaboration protocols, the development of knowledge-sharing platforms, the implementation of collective assessment mechanisms, and the preparation of a regional innovation experimentation space that is open to the people of Wajo Regency are inevitable and the main needs.

Respondent Identity in the Perspective of Regional Innovation

The respondent profile is not just a representation of statistical data but rather a strategic asset in realizing substantive, inclusive, and sustainable regional innovation. From the perspective of preparing the SIDa Strengthening Roadmap, this also shows an inclusive, diverse, and comprehensive representation. The demographic composition reflects the potential of the Wajo Regency innovation ecosystem, which is characterized by multi-generations, cross-educational backgrounds, a mix of various professions, and has strong local roots.

Based on the data, it can be seen that the distribution of gender composition is relatively balanced between male and female respondents. The classification of respondents is done binary—male and female—based on administrative data or identity filling that refers to biological categories, rather than a broader spectrum of self-identity. Therefore, the use of the term "sex" would be more methodologically and conceptually appropriate, because this term refers to biological attributes that can be observed or recorded administratively, in contrast to "gender" which is more reflective of social and cultural identities that are subjective and can vary. The accuracy of this term is important to maintain accuracy in the methodological report as well as sensitivity to contemporary sociological issues and terminology in the social sciences. This adjustment not only strengthens the academic integrity of the research but also helps avoid ambiguity of interpretation, especially when the study results are used as a basis for public policy decisions based on demographic data. According to Parkin & Xiao (2022) regarding gender representation in regional innovation, equality of participation is an important prerequisite in creating an inclusive innovation ecosystem. This is in line with the principle of PP No. 38 of 2017, which emphasizes the participation of all elements of society in the development of regional innovation.

Meanwhile, when viewed from the age distribution, the composition of respondents based on generation shows an interesting pattern. Respondents are dominated by millennials and Gen Z, while Gen X and the Baby Boomer generation are relatively limited in number. According to Schwab & Samans (2021), generational diversity is a strategic asset in developing regional innovation. Each generation brings a unique perspective: the younger generation

brings the spirit of technological disruption, while the older generation provides institutional experience and wisdom. This is also in line with the principle of PP No. 38 of 2017 concerning the importance of innovation that transcends generational boundaries.

Another uniqueness worth noting in managing regional innovation in Wajo Regency is the Education Level. Graphical data shows a diverse educational composition, where S1/Bachelor graduates are more dominant when compared to postgraduate graduates (S2/S3) and the existence of diploma and high school/equivalent graduates. Referring to the study by OECD (2023) regarding regional innovation capacity, diversity of educational backgrounds is a prerequisite for creating an innovation ecosystem rich in perspectives. PP No. 38 of 2017 emphasizes that regional innovation is not limited to a certain level of education but requires contributions across backgrounds.

The composition of the jobs/professions pursued by the community increasingly reveals the diversity of the respondents' professions needed to manage regional innovation in Wajo Regency. The representation of Freelance Workers, which reached 42.4%, was more dominant than other professions, including the representation of civil servants (ASN) at 37.6%. Rodriguez-Pose & Midelfart (2021) emphasizes that effective regional innovation requires multi-stakeholder collaboration. This finding is fully in line with the spirit of PP No. 38 of 2017 concerning regional innovation based on multi-stakeholders).

Considering the pattern of domicile and length of residence, most respondents have been domiciled for more than 10 years, spread across various sub-districts in Wajo Regency. According to Cornwall & Coelho (2021), experience and regional roots become important social capital in innovation. Length of stay indicates a deep contextual understanding of local dynamics, in accordance with the principles of PP No. 38 of 2017, which emphasizes innovation based on local wisdom.

Empirically, respondent identity data can be used to develop innovation platforms that can accommodate diverse perspectives, create spaces for dialogue across generations and professions, and strengthen diversity-based innovation capacity.

Reflection of Respondents' Responses (RRR)

Five (5) key variables were explored in the development of regional innovation ecosystems through a public survey involving 250 respondents with a Nine Level (1-9) assessment scale. According to Rodriguez-Pose & Midelfart (2021) on regional innovation, the study found a recent trend in assessing innovation dynamics based on public participation. This contribution is important for understanding the dynamics of regional innovation starting from the district level, especially in providing a strategic roadmap for policymakers in Wajo Regency. The results of the dialectical synthesis of the five variables needed for the preparation of the Wajo Regency SIDA Strengthening Roadmap 2025-2026 are presented in Table 1.

Table 1*Synthesis of Respondents' Needs in the SIDA Strengthening Roadmap*

Variables	Tesa/Antitesa	Sintesa	Solution/Action Plan
Variable X1: Innovative Human Resources (HR) and Innovation Infrastructure	The existence of conventional human resources with limited capacity. The demands of digital transformation and high innovation capabilities	According to Schwab & Samans (2021), a hybrid competency development model integrates local wisdom with cutting-edge technological skills. This approach creates an adaptive human resource capacity model that can transform traditional potential into sustainable innovation, focusing on developing digital literacy and contextual problem-solving skills.	Human Resource Capacity Development by means of: 1. Designing a hybrid competency development program 2. Integrating local wisdom with cutting-edge technological skills 3. Building a sustainable training platform that is responsive to the dynamics of change
Summary: Innovative Human Resources (HR) and innovation Infrastructure show interesting findings. The majority of respondents gave a score between 6 and 7, indicating a positive but not optimal awareness of the importance of innovative human resources. According to Mulgan's (2022) research on government innovation capacity, this finding illustrates significant development potential but requires strategic intervention.			
Variable X2: Supporting Policies and Regulations	Bureaucratic and rigid regulations Need for flexible and responsive policy framework	Referring to the OECD (2022) study on innovative governance, the synthesis points to a dynamic regulatory model capable of rapid adaptation. The concept of a "regulatory sandbox" is an alternative, allowing for policy experimentation with controlled risks while opening up space for more inclusive institutional innovation.	Transforming Policy and Regulation by: 1. Implementing a "regulatory sandbox" model 2. Creating a flexible policy framework that allows for innovation experimentation 3. Developing a mechanism for continuous evaluation and adaptation

Variables	Tesa/Antitesa	Sintesa	Solution/Action Plan
Supporting Policies and Regulations show a similar pattern. A rating range of 5-7 indicates the existence of regulations that are beginning to be responsive but not yet fully supportive of the innovation ecosystem. This aligns with the study (Yashiro, 2023) on regional innovation governance that emphasizes the importance of an adaptive policy framework.			
Variable X3: Dodeca-Helix Partnership (External Network Connectivity)	Limitations of networking between stakeholders Complexity of multidimensional collaboration needs	According to(Cai & Etzkowitz, 2020), the partnership model that goes beyond the triple helix to the dodeca-helix requires an interconnected ecosystem involving the Government, Regional Government, academics, industry, civil society, and grassroots communities. This approach creates an "innovation ecosystem" that is integrated and responsive to local dynamics .	Strengthening the Partnership Ecosystem by: 1. Building a cross-actor collaboration platform 2. Creating incentives for innovative collaboration 3. Developing knowledge and resource sharing protocols
The Dodeca-Helix Partnership (External Network Connectivity) displays interesting dynamics. Respondents gave varying ratings between 5-8, reflecting the complexity of the innovation network.. A study conducted by (Zhou & Etzkowitz, 2021) about the triple helix model in the context of regional development seems relevant to understanding these findings.			
Variable X4: Community Participation	Passive and minimal participation Demand for substantive and meaningful involvement	Cornwall & Coelho (2021) offers the concept of "transformative participation," which places the community as an agent of change, not just an object of development. This model encourages the development of participation mechanisms based on empowerment, equal dialogue, and strengthening	Accelerating Community Participation by: 1. Designing transformative participation mechanisms 2. Opening equal dialogue space between stakeholders 3. Developing a community-based empowerment system

Variables	Tesa/Antitesa	Sintesa	Solution/Action Plan
		community capacity in the decision-making process.	
Public Participation shows promising potential. The majority of respondents gave a score of 6-7, indicating a willingness to engage but still needing to strengthen participatory mechanisms. Referring to Cornwall & Coelho's (2021) research on public participation, this finding indicates a transitional stage towards more substantive engagement.			
Variable X5: Environmental & Social Sustainability (Improving Service Quality and Economic Growth)	Exploitative conventional development approach Holistic sustainable development paradigm	Referring to the framework of thought (Raworth, 2018) on the doughnut economy, the synthesis leads to a development model that balances social needs and ecological limits. This concept transforms the logic of linear growth into a regenerative cycle that takes into account human well-being and environmental sustainability	Mainstreaming Sustainability by: 1. Adopting a doughnut economic approach 2. Ensuring a balance between social needs and ecological limits 3. Creating a regenerative growth model
Environmental & Social Sustainability presents a holistic perspective. The rating range of 6-8 reveals a growing awareness of the sustainability dimension in regional innovation. This is in line with the framework of study (Raworth, 2018) about the doughnut economy which emphasizes the balance between social and ecological interests.			

Source: Research Results. Data Processed. 2024.

Each variable transforms from a static condition to a more complex, adaptive, and responsive dynamic. Based on the Hegelian dialectic in Matrix 1, Wajo Regency has the potential to develop an integrative, inclusive, and sustainable regional innovation model. In other words, it was revealed that an innovation ecosystem in Wajo Regency is transforming, as evidenced by the majority of assessments in the range of 5-7. This means that the public shows significant potential for developing regional innovation, although it still requires strategic intervention from the Wajo Regency Government to reach a more mature innovation stage. Realistically, the Wajo Regency Government can make breakthroughs and develop an "Adaptive Innovation Governance" approach to be able to synergize local potential with global demands, create an innovation ecosystem that is characterized, responsive, and sustainable for Inclusive Development and improve the performance of the Wajo Regency regional government.

Viewed from the theoretical implications, this contributes to developing a regional innovation model based on WM, which places humans and the environment as the main focus of transformation. However, when viewed from its practical implications, this model can be used as a strategic framework for the Wajo Regency Government, especially in designing and implementing a comprehensive, inclusive, and sustainable innovation system.

Conclusion and Recommendation

In addition to identifying, inventorying, and mapping regional innovations in the Wajo Regency, this study seeks to formulate a blueprint for systemic transformation toward a more meaningful, adaptive, and equitable future for regional innovation. It is known that through the SIDA Strengthening Roadmap, the Wajo Regency Government seeks to uncover the complexity of the innovation ecosystem that is currently transforming. The main findings indicate that Wajo Regency is strategically transitioning towards a more dynamic, inclusive, and sustainable innovation model.

Meanwhile, structurally, the Dodeca-Helix model identified in this study has represented a significant evolution from the conventional approach to a multidimensional innovation system. The integration of 12 stakeholders creates a collaborative infrastructure that enables the exchange of knowledge, resources, and innovation across borders. Likewise, an in-depth analysis of the composition of respondents also reveals a wealth of perspectives that are the main capital for developing regional innovation. The diversity of generations, educational backgrounds, and professions is fundamental in creating a responsive and adaptive innovation ecosystem. This is because the five key variables - Innovative Human Resources, Supporting Policies, Dodeca-Helix Partnerships, Community Participation, and Environmental & Social Sustainability - show an assessment pattern in the range of 5-7, indicating significant potential but requiring strategic intervention. The study recommends that the Wajo Regency Government ensure the institutionalization of I-Hub in order to accelerate several strategic matters, namely: (1) Strengthening human resources capacity through sustainable development programs; (2) Improving a more responsive regulatory framework; (3) Strengthening multi-actor network mechanisms; (4) Developing an inclusive public participation platform; and (5) Mainstreaming sustainable principles in every innovation initiative.

Comprehensively, this study focuses on the dynamics of regional innovation governance through a multi-actor approach. The focus on Wajo Regency not only provides a concrete local context but also presents a significant empirical contribution in understanding how synergy between stakeholders can be directed towards sustainable innovation-based development. The findings of this study offer practical guidance in the form of a relevant and applicable roadmap, which can be used by policymakers in the region to design, reformulate, or strengthen innovative and inclusive development policies. Although this study is regional in nature, the systematic analysis structure and strong theoretical approach make it an

important reference for other districts with similar characteristics who want to adopt a sustainable and collaborative innovation governance model.

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